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Grayson Scientific Manuscripts

by Capt David Hull

& Henry Foster

& Peter Anderson

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Magnetical
Observations

Made on board H.M.S. Conway
at Portsmouth Harbour &
On the South American Station.
By Captain Basil Hall, &
Mr Henry Foster Mth M^{te}
of that Ship.

In 1820 - 21 - & 1822.

Experiments on the Local Attraction
of HMS Conway in Portsmouth Harbour.

On the 24th of July 1820 Professor Barlow
of the Royal Military Academy at Wool-
wich came on board to superintend these
experiments which were instituted at his
suggestion, & by permission of the Lords
Commissioners of the Admiralty.

The object was to ascertain the amount
of the deviation in the direction of the
magnetic needle, by the combined
action of all the attracting matters on
board the ship, And as it was re-
quired to determine this quantity at
various positions of the ships head, she
was warped to one of the transporting
ways in the middle of the Harbour,
round which as a fixed centre, she
was successively drawn by means of
cawsers, & held steadily at the required

Joins whilst the observations were made.

As the amount of the local attraction was known to be a small quantity, it became of considerable moment in conducting the Experiment to reduce the chances of error in the observations as much as possible, & by a very ingenious device of Mr Barlow the error most likely to have contaminated the result was entirely removed. I mean that which arises from parallax, or a difference in the Bearing of an object at a finite distance by the mere change in the ship's place during the Experiment — or which might arise from taking bearings of the Sun, which independantly of its constant change of place, is too large an object

2 Direct the compass to in such nice
enquiries.

As Mr Barlow's method is, as far as I
know new, I shall give a particular
account of it.

A convenient spot on shore being
selected, no matter how far ~~or how~~
from the ship, or how near, but
where all cause of magnetic attraction
was absent, the Azimuth Compass
intended to be used in the Experiment
was landed, & placed on its stand
over some well marked point.

The Bearing of a distinct, small, &
tolerably distant object was then very
carefully & repeatedly taken & recorded.

On this occasion the Flag Staff over the
Market place at Gasport was taken
the situation of the Compass being on one
of the wharfs of the Dock Yard near

The King's Stairs. The Staff bore exactly
 $S 57^{\circ} W$ by Compass.

A Theodolite was now substituted
for the Compass, its centre being
carefully placed over the spot above
which the compass had stood.

The upper circle of the Theodolite was
then moved upon the lower one till
the vernier stood at 57° of the graduated
arch on the latter circle, & ~~the~~ being
clamped together, the Instrument was
turned in Azimuth till the flag
staff mentioned above was in the
centre of the field of view of the
Telescope fixed to the upper circle, &
the whole was then clamped.

The lower circle of the Instrument now
represented correctly the compass
card whose place it had been ^{made} to
occupy, for the 57^{th} degree upon it

was directed to an object which was known to bear 57 degrees from the South. Zero, therefore, of the Theodolite became South by Compass, 90° , the West, 180° the Compass or Magnetic North, & so on, of every degree on the circle. As long, then, as the lower circle was retained in its place by the clamp, it represented to all practical purpose a compass card; & by unclamping the upper circle, & moving it in Azimuth till any objects ^{became visible in} ~~were seen by~~ the Telescope, the bearing by Compass of that object would be correctly denoted by the angle at the Vernier. Thus the correct Magnetic Bearing of any ^{conspicuous} point on board the ship could be ascertained at any moment by merely bringing the Telescope to bear upon it & reading off on the circle.

These adjustments settled, the Compass was taken to the ship, & placed before the Mizzen mast, on a Stand sufficiently high to admit of its being seen from the Theodolite, & a signal being established it was easy to obtain at the same instant, the bearing of the Theodolite from the Compass on board, & the bearing of the Compass from the Theodolite on shore.

Now, only the last of these was a ~~true~~ correct Magnetic bearing, while that from the ship was exposed to the local attraction of the ship — the comparison of the two furnishing the amount of that effect, or what is called the Deviation caused by the local attraction.

On these principles, a succession of coincident bearings were taken

with the ship's head at each point of the compass, & afterwards compared & reduced to the following Table where the first column shows the position of the ship's head — the second the Deviated Bearing of the Theodolite from the ship, or that taken with the Compass under the influence of the local attraction — The third gives the Correct Magnetic Direction of the same line, or that which the uninfluenced Compass would have shown — & the last column gives the Difference of these two columns, or the amount of the Deviation caused by the local attraction.

The sign + is affixed to the Deviation when the North end of the Needle is drawn out of its ^{correct} magnetic place, towards the West, & — when it is drawn

to the East. These signs were adopted merely for distinction's sake, & because in the first case the angular ^{of the Theodolite} bearings from the North is increased, in the latter case diminished, by local attraction.

The Angles at the Theodolite, or the Correct Magnetic Bearings, were taken by Mr Foster. The Deviated Bearings, or those from on board the ship, were observed by myself, with one or two exceptions, which Mr Barlow Observed.

Of the results in the Tables it is only necessary to mention that they are the mean of several Bearings taken at each point, & that most of the circumstances of the Experiment were favourable, altho' the strong tide rendered it somewhat troublesome to steady the ship.

On inspecting the Table we observe that when the ship's head was to the westward of the Magnetic Meridian the North end of the Needle was drawn to the Westward, or forward, towards the ship's head; & when her head was to the East of the Magnetic Meridian a contrary Deviation was produced - but the North end of the needle was still, as before, drawn forward towards the ship's head.

Mr Barlow is of opinion that, while all things remain the same on board a ship, a different effect will be produced on the needle, in different latitudes, & as the Carvey was to be employed in South America he was desirous that his Theory should be put to the test 'at different Places. Unfavourable circumstances, &

especially a want of leisure, have
defeated this expectation in a great
measure, but the observations which
follow ~~seem~~ to show sufficiently
the importance of the enquiry
with reference to practical navigation
& they certainly have the effect of
stimulating scientific curiosity
more than ever. —

Table
Showing the amount of
Deviation

Produced on the Magnetic Needle
by the

Local Attraction of the Ship -

on board H.M.S. Conway

Portsmouth Harbour

July 1820

Position of the Ship's Head	Deviated bearing of the Theodolite; obs ^d on board by the Compass influenced by local attraction	Correct Magnetic Bearing of the Same line; obs ^d on Shore by the Theodolite	Amount of Deviation. +, when the N end is drawn West —, when it is drawn to the East.
South	N 96° E	N. 94°. 3' E	+ 1°. 57'
S. B. W.	95.20	92.57	+ 2.23
S. S. W.	95.10	92.19	+ 2.51
S. W. B. S.	94.8	91.0	+ 3.8
S. W.	94.2	90.47	+ 3.15
S. W. B. W.	93.35	90.15	+ 3.20
W. S. W.	93.30	88.32	+ 4.58
W. B. S.	92.10	87.32	+ 4.38
West... At this bearing the Mizen Mast intervened.			
W. B. N.	88.0	84.25	+ 3.35
W. N. W.	86.35	83.12	+ 3.23
N. W. B. W.	85.20	82.27	+ 2.53
N. W.	83.25	81.46	+ 1.39
N. W. B. N.	84.17	82.7	+ 2.10
N. N. W.	83.35	82.3	+ 1.32
N. B. W.	82.28	81.38	+ 0.50

Position of the Ship's Head.	Deviated Bearing. (Obs. ^d on board)	Correct Mag. ^{te} Bearing. (Obs. ^d on shore)	Amount of Deviation + N ^o end drawn to the Westward. - N ^o end drawn to the Eastward.
North	N 83°. 0' E	N 83°. 7' E	- 0. 7'
N. N. E.	84. 40	85. 47	- 1. 7
N. N. E.	85. 50	88. 4	- 2. 14
N. E. N. N.	83. 00	85. 13	- 2. 13
N. E.	82. 15	84. 58	- 2. 43
N. E. N. E.	82. 10	85. 31	- 3. 21
E. N. E.	83. 20	86. 34	- 3. 14
E. N. N.	85. 00	89. 5	- 4. 5
East	87. 50	90. 15	- 2. 25
E. N. S.	89. 30	91. 52	- 2. 22
E. S. E.	91. 00	92. 30	- 1. 30
S. E. N. E.	93. 20	94. 24	- 1. 4
S. E.	94. 10	95. 16	- 1. 6
S. E. N. S.	95. 50	96. 22	- 0. 32
S. S. E.	97. 00	97. 15	- 0. 15
S. N. E.	97. 00	95. 40	+ 1. 20

Date	Description	Amount	Balance
1890-1-1	Jan 1 Balance	100.00	100.00
1890-1-15	Jan 15 Cash	50.00	150.00
1890-1-30	Jan 30 Cash	25.00	175.00
1890-2-1	Feb 1 Cash	75.00	250.00
1890-2-15	Feb 15 Cash	30.00	280.00
1890-2-28	Feb 28 Cash	40.00	320.00
1890-3-1	Mar 1 Cash	60.00	380.00
1890-3-15	Mar 15 Cash	20.00	400.00
1890-3-31	Mar 31 Cash	80.00	480.00
1890-4-1	Apr 1 Cash	50.00	530.00
1890-4-15	Apr 15 Cash	30.00	560.00
1890-4-30	Apr 30 Cash	70.00	630.00
1890-5-1	May 1 Cash	40.00	670.00
1890-5-15	May 15 Cash	20.00	690.00
1890-5-31	May 31 Cash	90.00	780.00
1890-6-1	Jun 1 Cash	60.00	840.00
1890-6-15	Jun 15 Cash	30.00	870.00
1890-6-30	Jun 30 Cash	80.00	950.00
1890-7-1	Jul 1 Cash	50.00	1000.00
1890-7-15	Jul 15 Cash	30.00	1030.00
1890-7-31	Jul 31 Cash	70.00	1100.00
1890-8-1	Aug 1 Cash	40.00	1140.00
1890-8-15	Aug 15 Cash	20.00	1160.00
1890-8-31	Aug 31 Cash	90.00	1250.00
1890-9-1	Sep 1 Cash	60.00	1310.00
1890-9-15	Sep 15 Cash	30.00	1340.00
1890-9-30	Sep 30 Cash	80.00	1420.00
1890-10-1	Oct 1 Cash	50.00	1470.00
1890-10-15	Oct 15 Cash	30.00	1500.00
1890-10-31	Oct 31 Cash	70.00	1570.00
1890-11-1	Nov 1 Cash	40.00	1610.00
1890-11-15	Nov 15 Cash	20.00	1630.00
1890-11-30	Nov 30 Cash	90.00	1720.00
1890-12-1	Dec 1 Cash	60.00	1780.00
1890-12-15	Dec 15 Cash	30.00	1810.00
1890-12-31	Dec 31 Cash	90.00	1900.00
1891-1-1	Jan 1 Balance	1900.00	1900.00

Mr Barlow afterwards ascertained
by Experiments with the same Compass
on shore, that a circular double plate
of iron 12 inches in diameter, if fixed
14 inches below ~~reached~~ the point
on which the card was supported, & 12
inches from the perpendicular line
passing thro' that point, would produce
on the needle a similar set of deviations
with the foregoing, if the plate were
carried round the Compass in the
manner the ship's head had been drawn
round in the foregoing Experiment. And
his idea was, that as this plate at
one place (Portsmouth) was capable, if
affixed to the Compass, of producing
in all positions, an effect precisely
equal to that produced by the local
~~of~~ attraction of the ship in correspon-
dent positions - so it might be

expected to produce in other Latitudes
an effect equal to what the local
attraction of the ship would ^{then} produce,
be that what it might. In short,
Mr Barlow calculated that whenever
the Plate was attached to the Compass
on board ship it would by its action,
cause the needle to deviate from the
position it stood at before the plate
was affixed, by a quantity equal
to what the action of the ship's attraction
had already drawn it from the correct
magnetic position⁺. and if so, that a
ready means was evidently afforded
of inferring what the original deviation
was, & consequently coming at the
correct Variation of the Compass.

It is almost needless to state that in
all this it is supposed that, the same
compass is used - in the same position -

that it is the same plate which is used,
that the same arrangement of guns,
ballast, tanks &c continues ~~throughout~~
~~the~~ during the whole course of the
Experiments.

In Inclination the following is the
method which was pursued.

A set, or several sets of Azimuths
were taken, without the Plate. Then
another set, or sets, with the Plate
affixed -- the ships head, & all other
circumstances remaining the same.

The Variation of the Compass was
now computed from these observations
That Variation resulting from the first
Azimuths, taken without the Plate, is
affected simply by the local attraction
of the ship & may be termed the
Deviated Variation. That resulting
from the Azimuths when the Plate

was affixed, ~~may~~ is affected by an
action twice as great, first by the
Ship & next by the Plate, & may be
denied the Doubly Deviated Variation.
The difference between these Variations
is the amount of the local attraction,
or the Deviation, & this applied to
the Deviated Variation gives the Correct
Magnetic Variation. -

It is easy to see how this Correction
is to be applied, by merely observing
whether the North end of the Needle has
been drawn to the West^d or to the
East^d - by the application of the Plate
& considering that the Ship's attraction
^{must} ~~would~~ have had a similar effect
on the needle.

The following Observations were made at Sea by Mr Foster under my Superintendence, & occasional assistance. The Instrument used was an Azimuth Compass made by Messrs W & T. Gilbert of London, & lent to me by the makers at the suggestion of Professor Barlow. It is so contrived that the Observer reads off the Angle at the same time that he observes it, & is in other respects admirably adapted for Practice, not only on such occasions as this when much delicacy is required, but also in surveying, & in piloting ships by means of charts & bearings. The Azimuth Compass at present supplied to the Navy is altogether unfit for any of these purposes, even the most common.

M. Hall

Observations

Made at Sea

In order to determine the
Amount of Local Attraction
in different Latitudes
by means of
Mr. P. Barlow's Plate

By M. H. Foster
H. M. S. Conway.

170 It will save trouble to assign
the following letters to the different
elements in these Experiments.

(d.v.) = Deviated Variation, or that
observed without the Plate.

(d.d.v.) = Doubly Deviated Variation, or
that observed with the Plate affixed.

(c.) = Deviation or Correction, to be
applied to (d.v.)

(V.) = Correct Variation of the Compass,
or that freed from the effect
of Local Attraction.

Experiments

(1)

August.. 11th 1820. Lat^d 49 $\frac{1}{2}$ N. Long^d
5 $\frac{1}{4}$ W Ships Head by Compass W. S. W.

$$(d.v.) = 30.6 W.$$

$$(d.d.v) = \underline{32.26} W$$

$$(c.) = 2.20 = \text{westerly deviation}$$

$$(d.v.) = \underline{30.6} W$$

$$(V.) = \underline{27.46} W.$$

$$48 \quad 11 \quad 50 \quad \underline{27 \quad 16}$$

(2.)

August 12th 1820 Lat^d 47⁺ N. Long^d
8. 20' W. Ships Head W. S. W. by Compass.

$$(d.v.) = 29.20 W.$$

$$(d.d.v) = \underline{32.54} W$$

$$(c.) = 3.34 = \text{westerly Deviation.}$$

$$(d.v.) = \underline{29.20} W^{ly}$$

$$(V.) = \underline{25.46} W^{ly}$$

(3.)

August 13th 1820. Lat^d 45[°] N Long^d
11[°] W. Ships Head S.W.W. by Compass.

$$(d.v.) = 29. 13' W.$$

$$(d.d.v.) = \underline{33. 16' W.}$$

$$(C.) = 4. 3 \text{ westely deviation}$$

$$(d.v.) = \underline{29. 13' W.}$$

$$(V.) = \underline{\underline{25. 10' \text{ westely}}}$$

(4)

August 14th 1820 Lat^d 43^½ N. Long^d
12[°] W. Ships Head by compass S.W.W.

$$(d.v.) = 28. 11' W.$$

$$(d.d.v.) = \underline{30. 42' W.}$$

$$(C.) = 2. 31 = \text{westely deviation}$$

$$(d.v.) = \underline{28. 11' W.}$$

$$(V.) = \underline{\underline{25. 40' \text{ westely}}}$$

(5)

August 17th 1820 Lat^d 40.4 N Long^d
14.30 W. Ships Head S.W. by Compass.

$$(d.v.) = 28.13 W.$$

$$(d.d.v) = 29.55 W.$$

$$(C.) = 1.42 \text{ westerly deviation}$$

$$(d.v.) = 28.13 W.$$

$$(V.) = \underline{\underline{26.31 W.}}$$

(6)

August 19th 1820. Lat^d 36.11 N Long^d
14.53 W. Ships Head South by Compass.

$$(d.v.) = 23.56 W.$$

$$(d.d.v.) = \underline{23.54 W.}$$

$$(C.) = 0.2 \text{ Easterly deviation}$$

$$(d.v.) = \underline{23.56 W.}$$

$$(V.) = \underline{\underline{23.58 W.}}$$

(7.)

August 20th 1820 at 7^h Am in Lat 35.11

Long^d 14 W. Ships Head S. S. E. by Compass.

$$(d.v.) = 21. 20 W$$

$$(d.d.v.) = \underline{21. 12 W.}$$

$$(c.) = 0. 8 \text{ Easterly deviation.}$$

$$(d.v.) = \underline{21. 20 W.}$$

$$(V.) = \underline{\underline{21. 28 W.}}$$

(8)

August 22nd 1820 at 5^h Pm in Lat 30.7 N

Long^d 15. 47 W. Ships Head S. W. by Compass.

$$(d.v.) = 23. 7 W.$$

$$(d.d.v.) = \underline{25. 8 W.}$$

$$(c.) = 2. 1 \text{ westerly deviation}$$

$$(d.v.) = \underline{23. 7 W.}$$

$$(V.) = \underline{\underline{21. 6 W.}}$$

August 23rd 1820. Anchored off the
Town of Santa Cruz (Island of Teneriffe)
made observations for the Dip of the
needle, but owing to the ferru-
-ginous matter contained in the
stone of this Island, which is all
Lava, our endeavours to obtain
the amount of the Dip were
ineffectual.

(9)

August 28th 1820 at 7^h Am Lat^d 27 $\frac{1}{2}$ N
Long^d 17. W Ships Head S.W.^{by}W. by Compass

$$(d.v.) = 22.1 \text{ W.}$$

$$(d.d.v.) = \underline{24.19 \text{ W.}}$$

$$(C.) = 2.18 \text{ westerly deviation}$$

$$(d.v.) = \underline{22.1 \text{ W}}$$

$$(V.) = \underline{19.43 \text{ westerly}}$$

(10.)

Aug^t 28th P.M. in Lat^d 26 $\frac{1}{2}$ N. Long^d 18 W
Ships Head by Compass S.W.^{by}W.

$$(d.v.) = 21.52 \text{ W.}$$

$$(d.d.v.) = \underline{23.52 \text{ W.}}$$

$$(C.) = 2.00 \text{ westerly deviation}$$

$$(d.v.) = \underline{21.52 \text{ W.}}$$

$$(V.) = \underline{19.52 \text{ W.}}$$

(11.)

Aug^t 29th 1820 P.M. in Lat^d 24² N.
Long^d 19³/₄ W. Ships Head S. W. ⁶/₄ W. by Comp.

$$(d.v.) = 21. 5 \text{ W.}$$

$$(d.d.v.) = \underline{22. 26 \text{ W.}}$$

$$(c.) = 1. 21 \text{ westerly deviation}$$

$$(d.v.) = \underline{21. 5 \text{ W.}}$$

$$(V.) = \underline{\underline{19. 44 \text{ W.}}}$$

(12.)

Aug^t 30th 1820 P.M. Lat^d 21²/₃ N Long^d
21²/₃ W Ships Head by Compaſs S. W ²/₃ W

$$(d.v.) = 19. 43 \text{ W}$$

$$(d.d.v.) = \underline{20. 42 \text{ W.}}$$

$$(c.) = 0. 59 \text{ westerly deviation}$$

$$(d.v.) = \underline{19. 43 \text{ W.}}$$

$$(V.) = \underline{\underline{18. 44 \text{ W.}}}$$

(13)

Experimental Observations for the
Variation.

August 31st 1820 P.M. in Lat.^d 20° N.
Long.^d 23. 12 W the Variation was obs.^d when
the Ships Head was directed to the S.W.¹/₂ W.
South. and W¹/₂ N Points of the Compass.

First, Ships Head S.W.¹/₂ W.

$$(d.v.) = 18. 38' W.$$

$$(d.d.v.) = 19. 44 W.$$

$$(c.) = 1. 6 \text{ westerly deviation}$$

$$(d.v.) = 18. 38 W$$

$$(V) = 17. 32 W.$$

(13)

Second, Ships Head South

$$(d.v.) = 16.58 W$$

$$(d.d.v.) = 17.14 W$$

$$(C) = 0.16 \text{ westerly deviation}$$

$$(d.v.) = 16.58 W$$

$$(V.) = \underline{\underline{16.42 W}}$$

Third, Ships Head $W\frac{1}{2}N$.

$$(d.v.) = 18.37 W$$

$$(d.d.v.) = 20.17 W$$

$$(C) = 1.40 \text{ westerly deviation}$$

$$(d.v.) = 18.37 W$$

$$(V.) = \underline{\underline{16.57 W}}$$

Hence it appears that the Variation varies, at the different Points, when

the Plate was not fixed, as under.

$$\text{Ships Head} \left\{ \begin{array}{l} SW^6W = 18.38 \\ \text{South} = 16.58 \\ W^{\frac{1}{2}}N = 18.37 \end{array} \right\} W^{\frac{1}{2}} \text{Var}^{\frac{2}{2}}$$

$$\text{Greatest difference} = \underline{\underline{1.40}}$$

Then by attaching W. Barlow's Plate, the variations will stand as follows.

$$\text{Ships Head} \left\{ \begin{array}{l} SW^6W = 17.32 \\ \text{South} = 16.42 \\ W^{\frac{1}{2}}N = 16.57 \end{array} \right\} W^{\frac{1}{2}} \text{Variation}$$

$$\text{Greatest difference} \quad \underline{\underline{0.50}}$$

The greatest difference, being, when the Plate was not fixed.

(14)

September 1st 1820 in Lat^d 18 $\frac{1}{2}$ N Long^d
24 $\frac{3}{4}$ W. Ships Head SW^W by Compass.

$$(d.v.) = 17. 10 W$$

$$(d.d.v) = 18. 8 W$$

$$(c.) = 0. 58 \text{ westerly deviation}$$

$$(d.v.) = 17. 10 W.$$

$$(V.) = \underline{\underline{16. 12 \text{ W}^G}}$$

(15)

Sept^r. 3rd 1820 In Lat^d 15 $\frac{3}{4}$ N Long^d
25 $\frac{2}{3}$ W Ships Head South by Compass.

$$(d.v.) = 14. 2 W.$$

$$(d.d.v) = 13. 56 W$$

$$(c.) = 0. 6 \text{ Easterly deviation}$$

$$(d.v.) = 14. 2 W$$

$$(V.) = \underline{\underline{14. 8 \text{ W}^G}}$$

(16)

Sept^r 9th 1820 in Lat^a 8.51' N Long^a
19½ W. Ships Head S 86 S. by Compass.

$$(d.v.) = 14.37' W$$

$$(d.d.v.) = \underline{14.26' W.}$$

$$(c.) = 0.11 \text{ Easterly deviation}$$

$$(d.v.) = 14.37' W.$$

$$(V.) = \underline{\underline{14.48' W.}}$$

(17)

Sept^r 16th 1820 Lat^a 0.30' S Long^a
24 W. Ships Head by Compass S.W.

$$(d.v.) = 12.31' W.$$

$$(d.d.v.) = \underline{12.31' W.}$$

$$(c.) = \underline{0.00}$$

(18)

Sept^r. 17th 1820. In Lat^d 1. 24' S. Long^d
25° W. Ships Head by compass S.W.

$$(d.v.) = \overline{11.25}^{\circ} W$$

$$(d.d.v.) = \overline{11.23}^{\circ} W$$

$$(c) = 0 - 2 \text{ Easterly deviation}$$

$$(d.v.) = \overline{11.25}^{\circ} W$$

$$(V.) = \underline{\underline{11.27}}^{\circ} W$$

(19)

Sept^r. 20th 1820. In Latitude 9. 50' S
Long^d 31³/₄° W Ships Head S°W¹/₂ W.

$$(d.v.) = \overline{6.13}^{\circ} W$$

$$(d.d.v.) = \overline{5.57}^{\circ} W$$

$$(c) = 0.16 \text{ Easterly deviation}$$

$$(d.v.) = \overline{6.13}^{\circ} W$$

$$(V.) = \underline{\underline{6.29}}^{\circ} W$$

(20)

Sept^r. 22nd 1820 Latitude 14° P. Longth.

33¹/₄ W. Ships Head S°W ¹/₂ W. by compass.

$$(d.v.) = 4.28 W.$$

$$(d.d.v.) = 4.6 W.$$

$$(C) = 0.22 \text{ Easterly deviation}$$

$$(d.v.) = 4.28 W.$$

$$(V.) = \underline{\underline{4.50 W^y}}$$

(21)

Sept^r. 23rd 1820 In Latth. 15.52° P. Longth.

34 W Ships Head by compass S°W ¹/₂ W.

$$(d.v.) = 3.47 W.$$

$$(d.d.v.) = \underline{3.17 W.}$$

$$(C) = 0.30 \text{ Easterly deviation}$$

$$(d.v.) = \underline{3.47 W}$$

$$(V.) = \underline{\underline{4.17 W^y}}$$

(22.)

Sept^r 25th 1820 In Latitude $18\frac{2}{3}$ S. Long^d
 $36\frac{2}{3}$ W. Ships Head by Compass $SW\frac{1}{2}S$.

$$(d.v.) = 0.46 W.$$

$$(d.d.v.) = 0.26 W$$

$$(C.) = 0.20 \text{ Easterly deviation}$$

$$(d.v.) = 0.46 W.$$

$$(V.) = \underline{\underline{1.6 W^{\frac{1}{2}}}}$$

(23)

October 11th 1820. At Rio de Janeiro in
Lat^d $22.55'$ S. Long^d $43\frac{1}{4}$ W. Ships
Head by Compass W. S. W.

$$(d.v.) = 4.28^{\circ}$$

$$(d.d.v.) = \underline{4.08^{\circ}}$$

$$(C.) = 0.2 \text{ westerly deviation}$$

$$(d.v.) = \underline{4.28^{\circ}}$$

$$(V.) = \underline{\underline{4.4}} \text{ Easterly}$$

(24)

October 15th 1820 In Latitude 23.18° S
Long^d 43.12° W. Ships Head SSE by compass

$$(d v) = 4.0^{\circ} E.$$

$$(d. d. v.) = \underline{4.0^{\circ} E.}$$

$$(c) = \underline{0.0}$$

(25)

Oct. 16th 1820 In Lat^d 25.35° S Long^d
44° W. Ships Head SSW $\frac{1}{2}$ W by compass

$$(d v) = 4.59^{\circ} E.$$

$$(d. d. v.) = \underline{4.52^{\circ} E.}$$

$$(c) = 0.7 \text{ westerly deviation.}$$

$$(d. v.) = \underline{4.59^{\circ} E.}$$

$$(V) = \underline{\underline{5.6^{\circ} E.}}$$

(26.)

Oct^r 17th 1820. Latitude $27^{\circ} 0' S$. Long^d
 $46^{\circ} 10' W$. Ships Head by compass $SSW\frac{1}{2}W$.

$$(d.v.) = \overline{5.40}^{\circ} E.$$

$$(d.d.v.) = \underline{5.31}^{\circ} E.$$

$$(C) = 0.9 \text{ westerly deviation}$$

$$(d.v.) = \overline{5.40}^{\circ} E$$

$$(V.) = \underline{\underline{5.49}}^{\circ} E^{\frac{1}{2}}$$

(27)

Oct^r 18th 1820. In Latitude $28^{\circ} 41' S$
Long^d $46^{\circ} \frac{2}{3} W$. Ships Head SSW by compass

$$(d.v.) = \overline{7.24}^{\circ} E$$

$$(d.d.v.) = \underline{7.20}^{\circ} E.$$

$$(C) = 0.4 \text{ westerly deviation}$$

$$(d.v.) = \overline{7.24}^{\circ} E$$

$$(V.) = \underline{\underline{7.28}}^{\circ} E.$$

(28)

Oct.^r 25.th 1820. At Anchor of the Town
of Buenos Ayres. The Variation of
the Compass was observed to be
14. 20' E. S. The Plate being affixed
no difference could be observed: Ships
Head N.W. by Compass.

(29)

Nov.^r 23.rd 1820. In Latitude $52\frac{1}{2}^{\circ}$ S.
Long.^d 64. 40' W. Ships Head by Compass P. 68.

$$(d.v.) = 21.17^{\circ} \text{ E.}$$

$$(d.d.v.) = \underline{21.16^{\circ} \text{ E.}}$$

$$(c) = 0.1 \text{ westerly deviation}$$

$$(d.v.) = 21.17^{\circ} \text{ E.}$$

$$(V.) = \underline{\underline{21.18^{\circ} \text{ E.}}}$$

(30.)

Nov^r 25th 1820. In Latitude 55.40' S Long^d
W. Ships Head by compass S^W $\frac{1}{2}$ W.

$$(d.v.) = 23.49 \text{ } \mathcal{E}.$$

$$(d.d.v.) = \underline{24.38 \text{ } \mathcal{E}.}$$

$$(c.) = 0.49 \text{ Easterly deviation}$$

$$(d.v.) = \underline{23.49 \text{ } \mathcal{E}.}$$

$$(V.) = \underline{23.00 \text{ } \mathcal{E}.}$$

(31)

Nov^r 26th 1820. Diego Ramirez N 79[°] E
by compass N 79[°] E 6 or 7 miles. Ships
Head SW. Lat^d - Long^d.

$$(d.v.) = 26.28 \text{ } \mathcal{E}$$

$$(d.d.v.) = \underline{28.24 \text{ } \mathcal{E}}$$

$$(c.) = 1.56 \text{ Easterly deviation}$$

$$(d.v.) = \underline{26.28 \text{ } \mathcal{E}.}$$

$$(V.) = \underline{24.32 \text{ } \mathcal{E}.}$$

(32)

Nov^r. 30th 1820. In Lat^d 60. 46 S.

Long^d 72^W. Ships Head N⁶ E by Compass.

$$(d.v.) = 27. 37^{\circ} E.$$

$$(d.d.v.) = \underline{27. 21^{\circ} E}$$

$$(C.) = 0. 16 \text{ Westerly deviation}$$

$$(d.v.) = \underline{27. 37^{\circ} E}$$

$$(V.) = \underline{\underline{27. 53^{\circ} E.}}$$

Circumstances not very favourable

(33.)

Dec^r. 1st 1820 in Lat^d 60. 56 S Long^d.

72^W. Ships Head by Compass S.W. by S.

$$(d.v.) = 30. 3^{\circ} E.$$

$$(d.d.v.) = \underline{32. 27^{\circ} E.}$$

$$(C.) = 2. 24 \text{ Easterly deviation}$$

$$(d.v.) = \underline{30. 3^{\circ} E.}$$

$$(V.) = \underline{\underline{27. 39^{\circ} Easterly}}$$

(34)

Dec^r. 3rd 1820 in Lat^d 60. 36' S. Long^d
77³/₄ W Ships Head W¹ N² N by compass

$$(d.v.) = 30. 31 \text{ E}$$

$$(d.d.v.) = \underline{33. 15 \text{ E.}}$$

$$(c.) = 2. 41 \text{ Easterly deviation}$$

$$(d.v.) = \underline{30. 31 \text{ E}}$$

$$(V.) = \underline{27. 47} \text{ Easterly}$$

X

(35.)

Dec^r. 7th 1820 Pk In Lat^d 57. 38' S.

Long^d 84. 10' W. Ships Head W. N. W. by compass

$$(d.v.) = 28. 18 \text{ E. } \frac{1}{2}$$

$$(d.d.v.) = \underline{30. 35 \text{ E.}}$$

$$(c.) = 2. 17 \text{ Easterly deviation}$$

$$(d.v.) = \underline{28. 18 \text{ E.}}$$

$$(V.) = \underline{26. 1} \text{ Easterly}$$

(36)

Dec^r 14th 1820. In Lat^d 43³ P. Long^d
79. $\frac{1}{2}$ W. Ships Head N $\frac{3}{4}$ W. by Compass.

$$(d.v.) = 18.50 \text{ E.}$$

$$(d.d.v.) = \underline{19.14 \text{ E.}}$$

$$(C.) = 0.24 \text{ Easterly deviation}$$

$$(d.v.) = \underline{18.50 \text{ E.}}$$

$$(V.) = \underline{18.26} \text{ Easterly}$$

(37.)

Dec^r 16th 1820 In Lat^d 39. $\frac{1}{2}$ P. Long^d
78 $\frac{1}{4}$ W Ships Head N^o 8 by Compass.

$$(d.v.) = 17.16 \text{ E.}$$

$$(d.d.v.) = \underline{17.20 \text{ E.}}$$

$$(C.) = \underline{0.4}$$

The difference altho contrary to Theory
being so trifling, it is evident
that when the Ships Head is in, or
near the Magnetic Meridian, the

Compass is not influenced by attaching the Plate, neither is it for a similar reason acted upon by the local attraction of the ship

(38)

Decr. 17th 1820. In Lat^d 36. 30' S
Long^d 75 ²/₃ W Ships Head N N E. by Comp.

$$(d.v.) = 15.57^{\circ} \text{ E.}$$

$$(d.d.v.) = \underline{15.43^{\circ} \text{ E.}}$$

$$(C.) = 0.14 \text{ westerly deviation}$$

$$(d.v.) = \underline{15.57^{\circ} \text{ E.}}$$

$$(V.) = \underline{16.11^{\circ} \text{ Easterly}}$$

(391

Jan^y 9th P.M. 1821. the following
Azimuth was observed on shore at
Valparaiso In Lat^o 33. 1' S Long^o 71¹/₂ W

True Azimuth = S 77. 21 W

Magn^t. Azimuth = S. 62. 38 W.

Variation = 14. 43 Easterly

Dip of the Needle.
at Valparaiso.

Dip Face East (of South end of needle) = 39. 2

— West ————— Do ————— 38. 32

Error of Instrument ————— — 7

Intensity. Face East — arc 30 — 42. 5 Vol^{ts} = 120. ^{Sec. 2}

— West — " — 42. 5 — = "

— South — " — 33. 8 — = "

— North — " — 34. — = "

~~171~~ At Valparaiso.

On the 26th of January 1821 The Ship was swung after the manner before described in Portsmouth Harbour, with a view of finding the effect produced by the attractive matter on board.

The following Table exhibits the effect produced, which being so extremely small at all Points, may be in a great measure attributed to errors of observation.

The mark + is prefixed to the difference, when the Deviated Magnetic Bearing from the Ship was greater than the correct Magnetic Bearing denoted by the Theodolite: and - when contrary.

That is to say, it is marked + when the South end of the Needle

is drawn to the Eastward, and
— when drawn to the Westward.

Table

Shewing the Amount of

Deviation

Produced on the Magnetic Needle

by the

Local Attraction of the Ship.

at Valparaiso

Jan^y 1821.

Position of Ship's Head	Deviated or Compass Bearing of Theodolite obs ^d on board.	Correct Magnetic Bearing obs ^d on shore by Theodolite.	+ When South end of needle was drawn to the Eastward & - when drawn to the Westw ^d .
North	S. 52.00 W	S 52.37 W	- 0.37
N ^o E.	- 52.5 "	52.23	- 0.18
N. N. E.	52.15	52.5	+ 0.10
N. E. ^o N.	51.40	51.23	+ 0.17
N. E.	51.10	50.44	+ 0.26
N. E. ^o E.	49.00	48.37	+ 0.23
E. N. E.	48.50	47.56	+ 0.54
E. ^o N.	46.15	45.27	+ 0.48
East.	44.50	43.57	+ 0.53
E. ^o S.	44.10	43.18	+ 0.52
E. S. E.	43.30	42.37	+ 0.53
S. E. ^o E.	42.50	42.31	+ 0.19
S. E.	42.30	42.46	- 0.16
S. E. ^o S.	43.00	43.42	- 0.42
S. S. E.	49.00	48.8	+ 0.52
S. ^o E.	49.00	48.56	+ 0.4

Position of Ship's Head	Deviated or Compass Bearing of Theodolite obs ⁿ on board	Correct mag- netic Bearing obs ⁿ on shore by Theodolite	+ when South end of the needle was drawn to the Eastw ^d . - when drawn to the Westw ^d .
South	S 49.10' W	S. 49.39' W	- 0.29'
S ⁶ W.	50.0	50.18	- 0.18
S.S.W.	50.0	49.28	+ 0.32
S.W. ⁶ S.	49.0	48.35	+ 0.25
S.W.	48.30	48.54	- 0.24
S.W. ⁶ W.	50.20	49.59	+ 0.21
W.S.W.	50.0	50.40	- 0.40
W. ⁶ S.	51.20	52.9	- 0.49
West	51.30	52.32	- 1.2
W ⁶ N.	52.40	53.9	- 0.29
WNW	52.40	53.15	- 0.35
NW ⁶ W.	53.00	52.50	+ 0.10
NW	53.00	52.10	+ 0.50
NW ⁶ N.	52.50	52.5	+ 0.45
NNW ⁶ W.	52.20	53.14	- 0.54
N ⁶ W.	52.20	52.47	- 0.27

(40)

Feb^y 12th 1821 At Callao In Lat^d
12. 3' S Long^d 77. 5' W. Ships Head
by Compass S 68 $\frac{1}{2}$ E.

$$(d.v.) = 9. 37' E.$$

$$(d.d.v.) = \underline{9. 24' E.}$$

$$(C) = 0. 13 \text{ westerly deviation}$$

$$(d.v.) = \underline{9. 37' E.}$$

$$(V) = \underline{9. 50' Easterly.}$$

(41)

March 1st 1821 In Lat^d 12. 27' S Long^d
78 W. Ships Head by Compass S.W.

$$(d.v.) = 9. 26' E$$

$$(d.d.v.) = \underline{9. 38' E.}$$

$$(C) = 0. 12 \text{ Easterly deviation}$$

$$(d.v.) = \underline{9. 26' E.}$$

$$(V) = \underline{9. 14' Easterly}$$

(42)

March 2nd 1821 In Lat.^d 14. 18' Long.
80. 20' W. Ships Head S.W. by Compass.

$$(d.v.) = 10. 16' E$$

$$(d.d.v.) = \underline{10. 38' E.}$$

$$(C) = 0. 22 \text{ Easterly deviation.}$$

$$(d.v) = \underline{10. 16' E.}$$

$$\underline{9. 54} \text{ Easterly.}$$

(43)

March 4th 1821 In Lat.^d 18. 57' Long.
85 W. Ships Head by Compass S.S.W.

$$(d.v.) = 10. 10' E.$$

$$(d.d.v.) = \underline{10. 30' E.}$$

$$(C) = 0. 20 \text{ Easterly deviation.}$$

$$(d.v.) = \underline{10. 10' E.}$$

$$(V) = \underline{9. 50} \text{ Easterly}$$

(44)

March 6th 1821 In Lat^d 23. 30' S.

Long^d 87. 52' Ships Head S⁶W by compass.

$$(d.v.) = 10. 26' E$$

$$(d.d.v.) = \underline{10. 26' E.}$$

$$(c) = \underline{00. 00}$$

(45)

June 7th 1821 at Arica In Latitude
18. 28' S. Long^d 70¹/₄ W. Ships Head
by compass S W.

$$(d.v.) = 10. 25' E.$$

$$(d.d.v.) = \underline{11. 3' E.}$$

$$(c) = 0. 38 \text{ Easterly deviation}$$

$$(d.v.) = \underline{10. 25' E.}$$

$$(v.) = \underline{9. 47} \text{ Easterly}$$

(46)

At Ancon In Lat^d 11. 46' Long^d 77. 8' W. The following observation for the Dip of the Magnetic Needle was made July 26th 1821.

Face West

Obs ^d Dip (South)	—	6. 00
Face East obs ^d Dip	—	6. 45
Mean = obs ^d Dip	=	6. 22,5
Error of Needle		— 7
Dip of the Needle South	=	<u>6. 15,5</u>

Intensity

Face East	are 30	—	19. 7	=	60 ^{sec.}
D. West	"	—	19. 4	=	60"
D. South	"	—	6. 2	=	60"
D. North	"	—	6. 5	=	60

12 Thursday July 26th 1821 Landed in the
Bay of Ancon for the purpose of de-
termining the number of degrees
that the Plate would produce, by
first observing the Bearing of a
well defined object without the
Plate, and afterwards affixing the
Plate in its assigned Place, and
by turning the Leg holding the
Plate from North to West, and
so on round the Compass.

The Difference of Bearings
are as follows.

I

Plate Leg North
without the Plate
Bearing by mean of 2 Obs^{ns} N 52.45 W

The Plate was then Affixed and

the Mean of two observations on the

Bearing of the same Object = $N. 52.45$

D. without the Plate = $N. 52.45$

00.00

(2nd)

Plate Leg West
without the Plate

Bearing by Mean of two Obs^{ns} — $N. 52.50 W$

with Plate affixed

Bearing by Mean of two Obs^{ns} = $N. 52.27 W$

D. without the Plate — $N. 52.00 W$

Amount of the Attraction of 0.27

the South end of the needle to the westward

or towards the Plate — but it is so

trifling that in my opinion, it may

be attributed to the error in Observation

or want of delicacy in the Instrument.

(3rd)

Plate Leg South
without the Plate

Bearing, by mean of two obs^{ns} = N 51.40' W

with Plate affixed

Bearing, by mean of two obs^{ns} = N. 51.40' W
D. without the Plate = N 51.40' W
No Attraction — 00.00

(4th)

Plate Leg East
without the Plate

Bearing, by mean of two obs^{ns} = N 52.5' W
with Plate affixed

Bearing by mean of two obs^{ns} = N 52.7' W
Amount of Attraction = 0.2

(47)

at Guayaquil in Lat^d 2.13 S.

Longitude $79^{\circ}\frac{3}{4}$ W. the following
Observation was made on the 27th
Dec. 1821 for the Dip of the needle.

Face East

Obs^d Dip (North) = 12. 19

Face West. Obs^d Dip = 12. 18

Mean = obs^d Dip = 12. 18, 5

Error of needle — — — — — 7

Dip of the needle (North) = 12. 11, 5

Intensity

Face East	At 30°	19. in 60."
& West	"	20 in 60"

Guayaquil River Dec. 26th 1821

Landed on the north end of the Isl^d
of Santay and observed the Bearing
of a well defined object on the
^{side} opposite of the River, in the follow-
-ing manner, with a view of
determining whether Professor Barlow's
Plate would have any influence
on the Compass.

1st
Plate Leg South
without the Plate

Bearing by mean of two obs^{ns} - N 57. 50 W

The Plate was then affixed and
the Bearing by mean of two obs^{ns} = N 57. 10 W
D. D without the Plate = N 57. 50 W

amount of attraction wh^{ch} is within 0. 40
the Probable errors of obs^{ns} -

(2nd)

Plate Leg West
without the Plate

Bearing by mean of two Obs^{ns} = $N 57.0^{\circ} W$

The Plate was then affixed and
the Bearing by mean of two Obs^{ns} = $N 57.0^{\circ} W$
being exactly the same as that
without the Plate.

(3rd)

Plate Leg North
without the Plate

Bearing by mean of two Obs^{ns} = $N 56.35^{\circ} W$

The Plate was then affixed,
& the Bearing by mean of two Obs^{ns} = $N 56.57^{\circ} W$

D. without the Plate = $N 56.35^{\circ} W$

Amount of attraction — 0.22

(4th)

Plate Leg East
without the Plate

Bearing by Mean of two Obs^{ns} = N 57.0 W

The Plate was then affixed and
the Bearing by Mean of two Obs^{ns} = N 56.50 W

Dr. D without Plate = N 57.0 W

Amount of Attraction ——— 0.10

(5th)

Plate Leg S. W.
without the Plate

Bearing by Mean of two Obs^{ns} = N 56.25 W

The Plate was then affixed and the
Bearing by Mean of two Obs^{ns} = N 56.27 W

Dr. D without Plate = N 56.25 W

Amount of attraction = 0.2

th
(6)

Plate Leg N.E.

without the Plate

Bearing by mean of two obs^{ns} = N 57.5 W

The Plate was then affixed and
the Bearing by mean of two obs^{ns} = N 57.17 W
Do. Do. without Plate = N 57.5 W
Amount of attraction = 0.12

Henry Foster

Remarks on the preceding
Experiments by D Barlow,

Some doubt having been enter-
tained as to the accuracy of
the theoretical principles upon
which my proposition for
correcting the local attraction
was founded, I propose to
show that the experimental
results so obligingly forwarded
to me by Cap^t Hall, from lat
51° N to lat 60° S, are precisely
consistent with, and demonstra-
tive of the truth of the prin-
ciples upon which I have pro-
ceeded.

I shall examine the results
in the order in which they
have been obtained and en-
deavour to draw from each
its fair and legitimate
conclusion.

Experiments at Portsmouth,

From these it appears that the local attraction of the Conway at and near the East and West points, amounted to about $1\frac{1}{2}^{\circ}$, and consequently a difference of 9° might arise in determining the Azimuth and variation, according as the vessel was on different courses, and the same error might in the same way, be introduced into the course. This fact being undeniable, the question is whether such uncertainties as these ought to ^{be} admitted in the present state of Nautical Science, if they can be avoided.

Experiments 1, 2, 3 4 - at Sea

These results show that the corrections can be made, and that after the proper deduction

for the attraction, as shown
by the plate, the variation
thence deduced, agrees much
nearer with the value as given
by the best variations, ^{charts} than it
would otherwise do

we have for example

Exp	Observed	Var.	Per. Var.	Chart
1	30° 6' W	27	46	25 30
2	29 30	25	46	25 0
3	29 13	- 25	10	25 0
4	28 55	25	40	24 0

although ~~now~~ ^{although} I by no means intend
to adopt any chart as an au-
thority, yet so near our own
shores, there is little doubt
that the chart here referred
to by agents, and issued by
the Admiralty, is not very
erroneous, and it will be seen
how much ^{more} near the corrected
variation agrees with it than
the variation obtained from
observation only

Experiments 5, 6, 7 & 12

The same inference is to be drawn from these results as from the former, except that as the dip of the needle diminishes rapidly from lat 36° N, the effect is not so great, particularly at all points between the SE, S. SW in consequence both of the increased directive force of the horizontal needle, and the rising of the plane of no attraction, and thereby diminishing the product ~~undirected~~ $\sin 2 \lambda \cos \lambda$.

The variation by observation; the same corrected, and from the Chart in these eight experiments are as follow

Exp.	Obs. Var.	Cor. Var.	By Chart
5	28° 13'	26 36	22 0
6	23 56	23 58	22 30
7	21 20	21 28	22 15
8	23 7	21 6	20 0
9	22 1	19 43	18 30
10	21 52	19 52	18 0
11	21 5	19 44	17 0
12	19 43	18 44	16 0

I have similar corrected observations made in nearly the same latitudes and longitudes, by Cap^m Baldy in H. M. S. Lover; which agree very nearly with the above; in Lat 40° 36, Long 18° 44 the Cor. Var. is given 25° 10', there cannot be therefore the least doubt that in the first of the above lines, the chart is wrong nearly 4 degrees — I have indeed no intention of quoting the chart as authority, but it is fortunate that the correction approaches the result towards it; for if the observed variations agreed nearer with the chart than the corrected ones, it might be said ~~that~~ that I was

introducing errors instead of
correcting them.

Experiment 13 The variations
here as taken with the ships
head in different directions,
shows very obviously the
advantage of the correcting
plate, by reconciling the obser-
vations with each other. It
would certainly have been
a more forcible example
if the experiment had been
made in a higher ^{latitude}, where
the attraction is greater. And
I shall have to mention another

instance with a considerable
southern
dep and the effect will be
found proportionally greater

Experiments 14, 15 & 18

These experiments all tend
towards a practical demon-
stration of the theory upon
which I have proceeded

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The power of the plate decreases very rapidly, as it ought to do, particularly towards the east and west points, as I have stated in my Essay.

It will be seen however that what little attraction is shown, is precisely such as we ought to expect; the north end of the needle being drawn forwards, so that ^{with} the ship's head towards the west, the west^{erly} deviation is increased and with the head to the east it is diminished (see Exp. 14 & 16, and at the south the deviation vanishes, or is at least reduced to 6' (see Exp. 15). But in Exp. 19, 20, 21 & 31, having crossed the magnetic equator, the change of effect, which I have stated in my Essay ought to take place, immediately becomes manifest

The south end of the needle being drawn forward, whereby the westerly variation, which was before increased with the ship's head towards the west, is now diminished; which is precisely the result I had predicted as the necessary consequence of ~~my~~^{the} theory— These remarks apply to the effect gradually increasing with the dip) to Lat $55^{\circ} 40' S$

Experiments 32, 33, 34—

These experiments are highly satisfactory, they were made in Lat $60^{\circ} S$, with the ship's head at $N 6 E$, $S W 6 S$, and $N W 6 N \frac{1}{2} N$; the correction is increased in one case to $2^{\circ} 44'$, and in another at $N 6 E$ it is only $16'$, yet the three variations agree with each other more nearly than

we could have reason to expect
being $27^{\circ} 53'$, $27^{\circ} 34'$, and $27^{\circ} 47'$
Expe. 35 36 37 & 39

These show again the same
decrease of effect in the gins
and in the plate, in approach-
ing the equator, from the
southward, as was before obser-
ved in approaching it from
the northward, and the same
non action at the East and West
points.

At Valparaiso, the dip being
under 39° the ship was rising
entirely round us at Portsmouth,
and although the results are
somewhat irregular, they
show that the general effect
is proportional to the cosine
of the dip in the two places,
and that there ^{are} ~~is~~ here four
points of no attraction as
there ought to be, in con-
sequence of the nearly vertical

Position of the plane of no
attraction

Exp. 40 41, & 44

These call for no particular
remarks; it will be sufficient
merely to say that they are
in every ~~respects~~ respect con-
sistent with the theory.

Experiment N^o 1, 2, 3, 4 on the

These are highly satisfactory.

Every attempt that has yet
been made (except my own,
to correct the local attraction,
has been founded on a suppo-
sition that the East and West
~~are~~ were the points of greatest
attraction, but according to
the ^{I have adopted} principle, it ought
~~to follow~~ to follow, that at and near
the magnetic equator, the
plane of no attraction being
then vertical, these points

instead of being those of
greatest attraction, ~~they~~ should
be points of no attraction
and such they are actually
found to be by these experi-
ments. The same results
are again obtained in the
next one, and last experi-
ments of the series; and
I consider it as one of the
best tests which could have
been had recourse to, for
deciding between ^{theory} ~~and~~ and
~~practice~~ ^{practice} - I need not add that
I have felt myself highly
gratified at the result, and
under great obligation to
Captain Hall and to Mr Foster
for the obliging care they have
taken in performing the
experiments.

I shall conclude by observing

that from the general results
of all these experiments,
which fully confirm those
sent me by Cap^m Baldey,
of H.M.S. Leven, as far as
the two voyages extend^{together}
that throughout the Atlantic
Ocean, the westerly variation
in the most recent charts,
is laid down considerably too
strong, and the line of no
variation brought some several
degrees too much to the
eastward.

I am in hope that the
extensive and severe test
to which the principles and
the rules which I have
exhibited have been now
submitted; viz. through more
than 110° of latitude and

on both sides of the conti-
nent of America; and the
complete agreement in every
respect between the results
furnished, and those deduc-
ible from the theory, will
remove every doubt that
might before have been
entertained of their prac-
ticability and accuracy.

This is all that concerns me
as a mathematician; how
far the subject may be con-
sidered deserving of atten-
tion from our naval boards
is not for me to determine.
I shall ^{only} observe that it was
the importance given to the
enquiry in 1819 which led
me to undertake the inves-
tigation, and I cannot con-
ceive that any result

more accurate, or means
more simple, could possibly
have been expected.

Peter Barlow

List of Double stars &c observed with
a $3\frac{1}{2}$ inch Achromatic telescope of ~~Prof~~
Professor Barlow's construction.

	Star's Name	R A		Decl.	Dist
		h	m		
1	π Andromed.	0	6	7. 49 N.	83.9
2	η Cassiopeæ.	0	38	56. 51 N	8.7
3	Polaris	0	58	88. 22 N	18.7
4	α Cassiopeæ	0	30	55. 33 N	
5	ψ Cass.	1	13	67. 18 N	33.3
6	δ Trianguli	2	2	27. 27 N	3.88
7	δ Canum Ven.	12	48	39. 18 N	19.7
8	γ Ursa Maj.	13	17	55. 52 N	14.6
9	α Bootis	14	7	52. 39 N	13.1
10	δ Bootis	14	10	52. 12 N	38.0
11	π Bootis	14	32	17. 12 N	6.8
12	ζ Bootis	14	43	29. 51 N.	8.6
13	β Bootis	14	44	49. 27 N	24.6

	R	A	Decl	
40 a Trianguli	2	8	27. 49 N	14. 84
41 γ Andromedæ	1	53	41 28	10. 905
42 η Persei 1 and 2	2	38	55 8	28. 9
43 1 and 3	.	.	.	3' 57". 1
44 a Piscium	1	53	1 53 N	5. 428
45 H.C. 124	2	4	29. 34 N	6. 067
46 ρ Tauri	4	9	26 54	56. 8
47 X Tauri	4	12	25 11	19. 9
48 62 Tauri	4	13	23 52	29. 0
49 γ Arietis 1 and 2	1	44	18 25 N	9. 10
1 and 3	—	—	—	3. 48. 1
δ Capriſuicæ	23	50	54 41 N	2. 924
a Geminor. α & β	7	23	32 17 N	5. 355
α & c				1. 10. 18
α and β				3. 17. 14
δ Geminor	7	9	22. 18 N	7. 24

ζ Coronæ Bor.	15	33	37	11 N.	7.16
γ Herculis	16	14	19	35 N	38.32
17 Draconis	16	32	53	17 N	4.5
μ Draconis	17	3	54	43 N	3.9
α Herculis	17	6	14	36 N	5.28
δ Herculis	17	8	25	3 N	28.8
3 Herculis	17	17	37	19 N	4.46
95 Herculis	17	54	21	36 N	6.6
70 p Ophiachi	17	56	2	33 N	4.26
4, ε Lyrae	18	38	39	27 N	4.0
Deblissima intere and 5 Lyrae	18	38	39	27 N	5.3 ±
5 Lyrae	18	38	39	27 N	3.84
ζ Lyrae	18	38	37	25 N	46.2
β Lyrae	18	43	33	10 N	45.7
η Lyrae	19	8	38	51 N	29.3
β Cygni	19	24	27	35 N	34.3
α Aquilæ	19	42	8	24 N	—
α Capricorni.	20	8	13	38	—

There are two very minute stars accompanying
α capricorni.

14	γ Delphini	1 and 2	20	38	11	29 N	12° 31'
	—	1 & 3	—	—	—	—	2° 20' 8"
5	β Cephei		21	26	69	46 N	13° 16'
6	μ Cygni	1 and 2	21	36	27	50 N	5° 7'
		1 & 3	—	—	—	—	3° 37' 4"
17	ϵ Cephei		21	58	63	45 N	5° 8'
38	ζ Aquarii		22	20	0	57 S	84° 9'
39	δ Cephei		22	23	57	30 N	41° 5'
	λ Orionis		5	25	9	48 N	55° 74'
	ϵ Orionis	A. B.	5	27	6	2 S	12° 08'
		A. C.	—	—	—	—	49° 7'
	σ Orionis	A. B.	5	30	2	48 S	12° 9'
		A. C.					42° 7'
		A. D.					3° 30' 8"
		A. G.					5° 10' 1"
		A. H.					8° 45' 3"
		D. E.					11° 1'
		D. F.					1° 8' 25"
	ζ Orionis	A. B.	5	32	2	8 S	2° 6'
		A. C.

Stat Lin Def — — —

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12 Log Reciprocals for 12 engine work

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